

Photopolarimetry in Remote Sensing

Edited by

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Photopolarimetry in Remote Sensing

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NATO Advanced Study Institute

NATO ASI on "Photopolarimetry in Remote Sensing"

Yalta, Ukraine, 20 Sept. – 3 Oct. 2003

Directors: Gorden Videen and Yaroslav Yatskiy



Photopolarimetric remote sensing is vital to fields as diverse as medical diagnostics, astrophysics, atmospheric science, environmental monitoring and military intelligence. Researchers currently exploit the information contained in the polarization using numerous tools. This NATO ASI provides the opportunity to learn many of the techniques developed, share research experiences and pursue collaborative efforts. We will bring researchers together to learn and share well developed techniques from other disciplines.

One example of the interdisciplinary nature of this topic is a polarization feature seen in many astronomical bodies near opposition. Because the TE-polarization state dominates the scatter from both Fresnel reflections and Rayleigh-dipoles, scattered light tends to be positively polarized, i.e., TE-polarized. However, coherent interference of multiply scattered rays enhances the TM state, resulting in a polarization minimum in the backscattered direction. The US Army Research Laboratory and Navy Research Laboratory are investigating the feasibility of using this minimum as part of an integrated detector system for biological warfare agents.

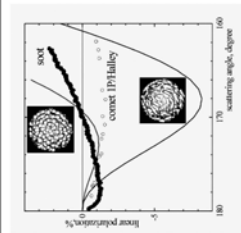


Figure 1: Polarization of light observed from comet 1P/Halley and carbon soot, and calculated from spore agglomerates.

Polarimetric remote sensing is used to determine microphysical properties of cloud and atmospheric aerosols. This research has matured since the discovery of sulfuric acid particles in the Venus atmosphere in the 1970s to the recent plans to develop long-term global climatology of terrestrial aerosols from a NASA earth-orbiting satellite in the framework of the US Climate Change Research Initiative and from National Polar Orbiting Operational Environmental Satellite System (NPOESS).

platforms managed jointly by DoD, NOAA, and NASA.

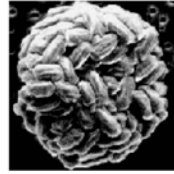


Figure 2: A cluster of biological spores and the planet Mars both may exhibit a negative polarization feature near opposition.

Both the US Army Research Laboratory and the Main Astronomical Observatory of the National Academy of Sciences of Ukraine are investing in this effort to establish a firm research foundation and build cross-disciplinary collaborations in remote sensing.

Kiselev *et al*, Sol Sys Res 35 338:2001
Mishchenko *et al*, J Atmos Sci 59 249:2002
Shkuratov *et al*, Icarus 159 396:2002
Zubko *et al*, Sol Sys Res 33 338:1999

Attendance Information: www.giss.nasa.gov/~crnim/Ukraine/k2003.htm
Email: POLAR2003@mao.kiev.ua or gvideen@arl.army.mil

Preface

The NATO Advanced Study Institute on “*Photopolarimetry in Remote Sensing*” met on the outskirts of the Ukrainian Black-sea city of Yalta, 20 September – 3 October, 2003. The focus of the meeting was recent advances in polarimetric methodologies used in remote sensing, including, but not limited to terrestrial and astrophysical characterization, medical diagnostics, environmental and military monitoring. Following the ASI, some participants attended an accompanying workshop focusing on international cooperation in Kyiv, 4 – 10 October.

The concept for the ASI was put forth at the NATO Advanced Research Workshop on “*Optics of Cosmic Dust*” (held in Bratislava, Slovakia, chaired by Gorden Videen and Miroslav Kocifaj) and was proposed by Nikolai Voshchinnikov, Michael Mishchenko and Vera Rosenbush. It should be noted

that none of these plotters actually co-chaired either of these events. Like most good things, the initial planning was facilitated by many bottles of vodka and brandy, too many to count actually. Because of the pioneering observational efforts and support infrastructure of the Main Astronomical Observatory of Ukraine, it was decided that the ASI would take place in Ukraine on the Black-sea coast. Preparation of the ASI began in earnest in the autumn of 2002 with formal acceptance of our NATO proposal.

While Co-chairs Yaroslav Yatskiv and Gorden Videen busied themselves with bureaucratic necessities, the actual preparations were made by the Local Organizing Committee. Special recognition is owed to Vera Rosenbush who is responsible for all the good things that happened. In addition to the LOC, we thank the management and staff of the Sanatorium Druzhba for extending the warmest of welcomes to the participants. Sasha Krysyuk participated in all the conference activities and insisted that we receive the best of everything. We could not have wished for a better host.



Chairman Yaroslav Yatskiv rallies the troops at the first conference dinner.



ASI and Sanatorium Druzhba management and staff stand in front of flags of the NATO ASI participant countries. Back row (left to right): Anatoliy Vid'machenko, Sasha Krysyuk, Klaus Jockers and Michael Mishchenko. Front row (left to right): Valentin Babenko, Tamara Bulba, Ivan Andronov, Irina Kulyk, Yuriy Shkuratov, Nikolai Kiselev, Anny-Chantal Levasseur-Regourd, Ted Kostiuk, Vera Rosenbush, Gorden Videen, Alexander Fedorov, Zhanna Platonova, and Yaroslav Yatskiv.

Many fields have made contributions to the art of polarimetry, and our goal was to select representative lecturers who have contributed to the various



The Swallow's Nest, symbol of the Crimea, is a short distance from the Druzhba.

aspects. We were lucky to have a group of outstanding lecturers willing to invest the time to provide illuminating and entertaining lectures on the fundamental research in their fields. This book is a compilation of significant contributions taken primarily from these key lectures. We are grateful to those who were able to devote the significant time and effort necessary to document this work.

While the lectures represent the key component of a NATO ASI, another critical component is providing opportunities for

interactions. Not only is this important for lecturers to elucidate key points and



Picnic at CrAO was a carnivorous affair. Shown (left to right): Ivan Mishchenko, Matt Easley, Olga Kalashnikova, James McDonald, Marina Prokopjeva, Daria Dubkova and Pavel Litvinov.

to provide details on a more personal level, but it is also critical to provide the time for the communications that ultimately will lead to advances and collaborations that will drive the field into the future. The LOC organized these activities that included an opening reception, two formal conference dinners and field trips to the Crimean Astrophysical Observatory (with a visit to the Uspensky Monastery and Chufut Kale), and tours of Livadia and Alupka

palaces, Ai Petra, and Sevastopol. In sum, we did our best to provide the necessary elements to commence fruitful collaborations, i.e., food, drink, and discussion, and hope our participant colleagues are able to turn this opportunity to their advantage.

Gorden Videen
Yaroslav Yatskiv
Michael Mishchenko

April, 2004

Organizational Structure

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Gorden Videen	United States Army Research Laboratory

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Participants of NATO ASI pose for a group photo in front of Sanatorium Druzhba.